RNS INSTITUTE OF TECHNOLOGY
Autonomous Institution, Affiliated to VTU

Estd : 2001

2024 Scheme
I Semester B.E. Degree Examination-Model Question Paper

Time: 3 hrs   **Max. Marks: 100**

Engineering Mathematics I (ME Branch)

Instructions to Candidates:
1. *Answer any 5 full questions, selecting at least one question from each module.*
2. *Missing data may be suitably assumed.*

Q.No.		Module-1	Marks	COs
Q1	**a**	.Find the angle of intersection of the pair of curves $r = a(1 - \cos\theta)$ and $r = 2a\cos\theta$.	6	CO2
	b	Derive angle between radius vector and tangent.	7	CO1
	c	Find the radius of curvature for $x^4 + y^4 = 2$ at $(1, 1)$	7	CO1
		OR		
Q2	**a**	Show that $r = 4\sec^2\frac{\theta}{2}$ and $r = 9\,cosec^2\frac{\theta}{2}$ the pair of curves cut orthogonally.	6	CO1
	b	Derive the radius of curvature of a cartesian curve.	7	CO1
	c	Find the Pedal equation of the curve $\frac{2a}{r} = 1 - \cos\theta$	7	CO1
		Module-2		
Q3	**a**	Expand $\log(1 + x)$ by Maclaurin's series up to the term containing x^4.	6	CO2
	b	Find the maximum and minimum values of the function $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$.	7	CO2
	c	A rectangular box open at the top is to have volume of 32 cubic ft. Find the dimensions of the box requiring least material for its construction.	7	CO2
		OR		
Q4	**a**	Using Maclaurin's series, Prove that $\sqrt{1 + \sin 2x} = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24} + \cdots$	6	CO2
	b	If $x + y + z = u, y + z = uv$ and $z = uvw$ find $\frac{\partial(x,y,z)}{\partial(u,v,w)}$.	7	CO2
	c	Find the volume of the greatest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	7	CO2
		Module-3		
Q5	**a**	Solve $x\frac{dy}{dx} + y = x^3 y^6$	6	CO3

b	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2}+\frac{y^2}{b^2+\alpha}=1$ where α is a parameter.	7	CO3
c	Solve $xyp^2-(x^2+y^2)p+xy=0$	7	CO3

	OR		

Q6	**a**	Solve $(x^2+y^2+x)dx+xydy=0$	6	CO3
	b	Water at temperature $10°C$ takes 5 minutes to warm up to $20°C$ at room temperature of $40°C$. Find the temperature of the water after 20 minutes.	7	CO3
	c	Find the general solution of the equation $(px-y)(py+x)=a^2p$ by reducing into Clairaut's form by taking the substitution $X=x^2, Y=y^2$.	7	CO3

	Module-4		

Q7	**a**	An experiment gave the following values:	6	CO4

v (ft/min)	350	400	500	600
t (min)	61	26	7	26

It is known that v and t are connected by the relation $v=at^b$. Find the best possible values of a and b.

	b	In a partially destroyed lab record only the lines of regression of y on x and x on y are available as $4x-5y+33=0$ and $20x-9y=107$ respectively. Calculate $\bar{x},\bar{y}$ and coefficient correlation between x and y.	7	CO4
	c	Ten competitors in a contest are ranked by two judges as follows:	7	CO4

x	1	6	5	10	3	2	4	9	7	8
y	6	4	9	8	1	2	3	10	5	7

Calculate the rank correlation coefficient.

	OR		

Q8	**a**	Fit a second-degree parabola $y=ax^2+bx+c$ in the least square sense for the following data and hence estimate y when $x=6$.	6	CO4

x	1	2	3	4	5
y	10	12	13	16	19

	b	Find the coefficient of correlation and the lines of regression for the data	7	CO4

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

	c	Compute the rank correlation coefficient for the following data	7	CO4

x	68	63	75	50	62	80	78	40	55	60
y	62	58	68	45	81	60	68	48	50	70

	Module-5		

Q9	a	Find the rank of the matrix $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$	6	CO5
	b	Use Gauss Jordan method to solve the system of equations $2x + 5y + 7z = 52, 2x + y - z = 0, x + y + z = 9$	7	CO5
	c	For what values of $\lambda \ and \ \mu$ so that the equations $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$ have (i) Unique solution (ii) No solution (iii) infinite number of solutions	7	CO5
		OR		
Q10	a	Using Rayleigh power method to find the largest eigen value and the corresponding eigen vector of the matrix $$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix} X^{(0)} = [1,1,1]^T$$	6	CO5
	b	Use Gauss Seidel method to solve the system of equations $20x + y - 2z = 17, 3x + 20y - z = -18, 2x - 3y + 20z = 25$	7	CO5
	c	Using modern mathematical tool write a program/code to test the consistency of the equations, $x + 2y - z = 1, 2x + y + 4z = 2, 3x + 3y + 4z = 1$	7	CO5